Engineering Summary of Tests Conducted and Submitted in the FCC's AirCell Proceeding

July 1, 2004

On March 28, 2002, AirCell requested a substantial expansion of its waiver to operate within the cellular spectrum bands, which includes the permanent authorization to occupy analog and *digital cellular* channels, and to allow its base stations to occupy up to 19 cellular channels simultaneously (6 channels were previously authorized).

In response to AirCell's request for a waiver extension, V-COMM submitted engineering test results and data to the Commission on April 10, 2003 on the compatibility of the AirCell system to operate with terrestrial cellular systems. V-COMM was contracted by Verizon Wireless, Cingular Wireless and AT&T Wireless to study the compatibility of the AirCell system. The results of V-COMM's extensive testing show that AirCell's air-to-ground system causes substantial harmful interference to both analog and digital terrestrial cellular networks.

AirCell also submitted test results to the Commission; however its flight tests were extremely limited, only representing the best-case scenario, and its interference tests utilized artificial test conditions with abnormally high noise levels masking the effects of its interference. Thus, AirCell's test results and conclusions are distorted representations of the impacts to terrestrial cellular systems.

AirCell also offers criticisms of V-COMM's flight tests and interference tests, however, these criticisms are without merit – AirCell attempts to cast aside test results that clearly show harmful interference to terrestrial cellular networks.

In addition, V-COMM includes herein an attachment entitled the "FCC Update on AirCell System Compatibility Tests," which further demonstrates: 1.) the base station antennas used in V-COMM's flight tests were not obstructed by trees; 2.) AirCell's noise measurements closely match V-COMM's noise measurements, but neither measurements supports AirCell's utilization of much higher noise levels in its digital compatibility tests; 3.) AirCell's 1997 flight tests were optimized for the best case (least interfering) scenario with the aircraft fuselage blocking the signal path toward the victim terrestrial site; and 4.) V-COMM's new measurements of actual AirCell customer calls are consistent with the power levels from V-COMM's previous flight tests, and further validate the harmful interference conclusions.

V-COMM's Extensive Testing Confirms AirCell Causes Substantial Harmful Interference to Terrestrial Cellular Networks

- V-COMM's flight tests included 10,000 air miles, four terrestrial antenna types, two aircraft antenna types, multiple aircraft types, and a variety of altitudes and aircraft orientations. The flight test results demonstrated signals as high as -72 dBm, frequently within the range of -90 to -100 dBm, and often well above -110 dBm, as received at victim terrestrial cell sites. At these levels, AirCell's signals will cause *substantial harmful interference* to the terrestrial cellular networks.[1] In some cases, AirCell signals are received at stronger levels than the terrestrial signals.[2]
- These signals will clearly disrupt and obstruct terrestrial cellular service. In fact, such harmful interference is occurring daily, even though the source of such interference is not traceable due to the inability to determine the lost calls attributed to AirCell. If AirCell's waiver extension is granted, there will be even more interference as AirCell adds more customers to its system. AirCell's operation clearly causes harmful interference, however it is defined.
- Further, our case study outlines the extent of the AirCell interference to the surrounding cellular network. It utilizes the highest used air corridor (DC to NY metro area), and shows as few as 200 or as many as 30,000 terrestrial calls would experience harmful interference from a single AirCell phone call on a single flight. As shown on page 14 of the attachment, the radius of harmful interference to the terrestrial system extends out to 56 miles from the aircraft using an AirCell phone.
- AirCell agrees with V-COMM's flight test results at fixed power (DPC Step 2),[3] which defines the path loss from aircraft to victim terrestrial site and represents the worst-case interference when AirCell phones are transmitting at maximum power. The maximum power level occurs on AirCell control channels *all the time*, and it occurs on AirCell voice channels for a significant portion of time.[4]
- In response to the FCC's (Dec. 18, 2003) request for real-world measurements of power levels, V-COMM measured actual AirCell customer calls from January to February of 2004. This new data collected from actual customers is consistent

[1] As demonstrated in V-COMM's interference compatibility tests, AirCell signal levels at -114 dBm clearly indicate harmful interference is occurring to the cellular networks using analog and digital technologies. When AirCell signal level are greater than or equal to -110 dBm, *substantial* harmful interference is occurring to the terrestrial networks, as demonstrated in our interference compatibility tests.

[2] AT&T Wireless' measurements indicate that approximately 30% of wireless calls are received below –100 dBm, and approximately 20% of wireless calls are received below –105 dBm, for a variety of its suburban and rural sites.

[3] See pages 25-26 of Section 2.3.c of *AirCell Engineering Review of V-COMM Reports* filed in the AirCell docket on June 9, 2003, and see AirCell's comparison flight results Table 2.3.c.1 reproduced on page 8 of the attached exhibit.

[4] For example, as indicated in actual measurements of AirCell customers' calls at the Altoona AirCell site, the maximum power level (DPC 2) was utilized 44% of the time.

with the power level measurements in V-COMM's earlier flight tests, which further validate these flight tests.[5]

- Despite the FCC's request of AirCell for real-world customer data, and despite AirCell's claim it has a million-mile database of flight test results, AirCell did not supply the Commission with the requested information from actual customer calls.

AirCell Relied on Limited and Distorted Testing, and Therefore Misrepresented the Interference it Produces

- To support its waiver extension, AirCell primarily relies on its 1997 flight data, which is extremely limited. Its flight data is not representative of the actual interference that occurs to the terrestrial system. In comparison to the 10,000 air-miles of flight testing that V-COMM performed, AirCell's flight tests only rely upon 850 miles of testing. This test represents only 1 aircraft orientation to the victim site, only 1 aircraft orientation to its serving site, only 1 type of aircraft antenna, and only 1 victim terrestrial antenna polarity (vertical) – each of which is optimized to exhibit the lowest transmit power and receive levels possible. It represents only an extreme best case (least interfering) scenario.[6]
- AirCell's digital compatibility tests are flawed and invalid. In an attempt to simulate real-world radio conditions, AirCell artificially injected abnormally high noise levels masking the effects of the harmful interference caused by its system. This test condition renders its tests completely invalid and irrelevant. AirCell never substantiated reasons for injecting these abnormally high noise levels, and actually submitted noise data on the record that contradicted its own assertions. In fact, AirCell's actual noise measurements closely match V-COMM's noise measurements of 18 terrestrial sites.[7] However, neither set of measurements (ours nor theirs) match AirCell's utilization of much higher injected noise levels. See the '23 dB Gap' between noise levels measured vs. noise levels used by AirCell, on page 25 of the attached exhibit.
- AirCell's digital compatibility tests also relied on the limited 1997 flight data, and therefore are flawed because the data is not representative of real world circumstances.

[5] Actual measurements of AirCell customers' calls indicate the two highest power steps (DPC 2, 3) are used 27% to 47% of the time, for 4 out of 5 sites studied. V-COMM's flight tests showed the Marlboro site (nearby New York City) occupying the two highest DPC levels for 33% of the time.

[6] See pages 26-28 of the attached exhibit for illustrations of the aircraft orientation utilized in AirCell's 1997 flight tests. It represents the best-case aircraft orientation with the lowest phone transmission power and lowest receive levels at the victim sites. The aircraft antenna always has an unobstructed view toward its AirCell serving site, and the aircraft's fuselage and horizontal stabilizer blocks the signal path to the victim terrestrial site.

[7] See pages 19-20 of the attached exhibit.

AirCell's Criticisms of V-COMM's Flight Tests and Interference Tests are Without Merit

- In response to V-COMM's flight tests, AirCell incorrectly claimed that the operator of the Marlboro site lowered the base station antennas below the tree line and affected DPC results. They also claimed that handoffs were not setup at this site. However, AirCell itself verified the installation and operation of the site, and optimized all the parameters. Further, these parameters are typical of other sites in its system. Thus, V-COMM's results are representative of the AirCell system.
    - Only the lowest inverted transmit antenna was partially blocked by tree foliage, and this antenna was not used in V-COMM tests; the other three antennas at Marlboro were used and were not obstructed by trees. This was verified through a tower survey by an independent contractor.[8]
    - The DPC settings were specified by AirCell, and were operating accordingly to its standards.
    - AirCell criticizes that handoffs were not setup, however our study of actual customer calls indicates that handoffs only occur 2% of the time. Thus, V-COMM's flight tests are representative of typical AirCell operations. Further, handoffs are typically not used by AirCell because of the economics of leasing long-distance trunk lines to cell sites that are over 160 miles away, located in non-adjacent cellular markets.
- In response to V-COMM's interference compatibility tests with AMPS, TDMA and CDMA technologies, AirCell claimed the tests conditions and data processing were not representative, however these claims have been proven to be incorrect, as well. The cell site's operating settings were exactly equal to the normal and specified vendor recommended values. Lucent confirmed that the data processing was correct, and AirCell's manipulation ("re-casting") of the data was invalid.
- In addition, Lucent observes that AirCell misunderstands the impacts to CDMA technology, and underestimates the interference potential to CDMA by a large margin. Lucent participated in the testing, provided assistance and guidance to V-COMM prior to and during the testing, and with post-processing of the test data. Finally, Lucent supports the V-COMM test results as presented to the Commission.

Conclusion

The evidence in the record is clear and overwhelming. It demonstrates that the AirCell system causes substantial harmful interference to terrestrial cellular service. Further, cellular phones are used by more than 50% of the public, and represent approximately 50% of the Emergency/911 calls made in the U.S. – it is not in the public interest to allow AirCell to cause harmful interference in the cellular bands. Therefore, AirCell's request to continue and expand its use of cellular spectrum for its air-to-ground operations should be denied.

[8] See pages 10-12 of attached exhibit for photographs of the antennas at the Marlboro AirCell site.